Effect of aeration on the treatment performance of constructed floating wetlands

Annelies M.K. Van de Moortel[a*] Erik Meers[a], Niels De Pauw[b], Filip M.G. Tack[a]

*corresponding author
[a]Department of Applied Analytical and Physical Chemistry, Laboratory of Analytical Chemistry and Applied Ecochemistry, Ghent University, Coupure Links 653, 9000 Gent, Belgium, Annelies.Vandemoortel@UGent.be; Erik.Meers@UGent.be; Filip.Tack@UGent.be;
[b]Department of Applied Ecology and Environmental Biology, Labratory of Environmental Toxicology and Aquatic Ecology, Ghent University, J. Plateaustraat 22, 9000 Gent, Belgium, Niels.Depauw@UGent.be

Three mesocosms simulating full scale retention basins (length: 1.5m; width: 0.8m; water depth: 0.9m) were constructed in January 2007. Two of them were equipped with floating macrophyte mats planted with *Carex* spp, mimicking constructed floating wetlands. The third mesocosm served as a control and did not contain a floating macrophyte mat. All three mesocosms were batch loaded (retention time 11 days) with domestic wastewater coming from a wastewater treatment plant. Aeration was provided by air diffusers at the bottom of one of the two CFWs at a rate of 3.1 L air min^{-1} m^{-3} water. The removal of total nitrogen (TN), ammonium-nitrogen (NH_4-N), total phosphorus (TP) and carbon (TOC, COD) was evaluated.

Providing aeration resulted in an improved removal of NH_4-N, total nitrogen (TN), total organic carbon (TOC), chemical oxygen demand (COD) and total phosphorus (TP) when compared to a non-aerated floating wetland. Removal efficiencies for the aerated and non-aerated wetland after 11 days were >99% and 43.2 ± 10.9% for NH_4-N, 67.9 ± 5.7% and 43.0 ± 8.1% for TN, 69.0 ± 5.3 and 22.6 ± 18.5 for TOC, 68.7 ± 5.0 and 55.2 ± 4.4 for COD, and 59.4 ± 2.9 and 35.1 ± 11.7 for TP. In the aerated system all NH_4-N was removed within 4 days whereas in the non-aerated wetland and control a gradual decrease was observed throughout the 11 day experiment. Furthermore, most removal occurred within the first 4 days in the aerated system. No significant difference in removal performance was observed in the aerated system after 4 or 11 days. Due to nitrification in the aerated wetland NO_3-N concentrations increased up to 5 mg L-1 whereas in the non-aerated wetland and control NO_3-N concentrations remained low (< 0.5 mg L^{-1}). Measurement of dissolved oxygen concentrations indicated concentrations higher than 10 mg L^{-1} whereas no oxygen was detected in the non-aerated system and control. To obtain a reduction of NO_3-N concentrations oxygen levels should be lower. Another steering factor for denitrification next to oxygen and temperature is the availability of an organic carbon source. Both TOC and COD concentrations were lower than respectively10 and 15 mg L-1 after 4 days of aeration and no significant removal of TOC was observed after that period. This could indicate that the carbon, still available in the wastewater, was not readily degradable and would, as such, not be suitable for the denitrifiers. The decrease of P in the aerated system was due to improved chemical precipitation of P with calcium, iron, magnesium and aluminium.

As pollutant removal is improved by aeration, shorter residence times and smaller installation footprints can be used. When using CFWs for treatment of combined sewer overflows or storm water, the foreseen buffer capacity can be used more optimally as the water can be quicker discharged.

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